

Analysis of Lost Creek Water Usage and Research on Residential Water Pricing and Conservation

for
Lost Creek MUD
Lost Creek Neighborhood Association
September 19, 2011
Paul Schumann

Summary

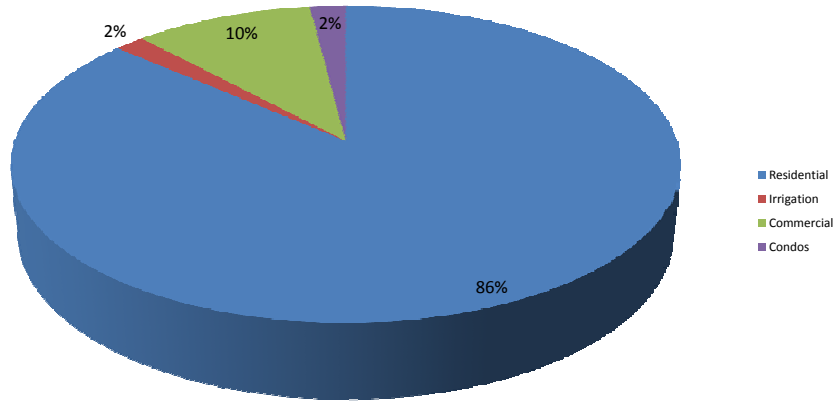
- Austin is increasing the wholesale price of water to the LCMUD by 19%.
- The tiered (increasing block) pricing structure for residential water approved by the LCMUD board would have produced an effective rate of \$4.61 (2009) and \$4.54 (2010) per 1,000 gallons for residences
- Matching a tiered (increasing block) pricing structure with a fixed supply cost and forecasting future usage is extremely complicated and difficult
- Residential water demand is inelastic (-0.35) with price
- Residential water demand is elastic (+3) with temperature
- Residential water demand is the largest (86%)
- Residential indoor water use is approximately 7,400 gallons per residence per month (43%)
- Residential outdoor water use is approximately 10,000 gallons per residence per month (57%)

Summary (cont.)

- Water savings as a result of increased pricing is roughly the same for an increasing block or flat rate (5%)
- Water use is not correlated with rain amounts
- Distribution of water users varies significantly by month
- Residences near the boundaries of increasing block pricing structure are affected most (positively and negatively)
- Water conservation results are highly variable, subjective and controversial
- Best indoor water conservation study indicated 17% reduction through 100% implementation of best plumbing practices and products
- For LCMUD largest water use is residential outdoor. Impacts to that can only be achieved through radical changes to landscaping

RESIDENTIAL WATER USE ANALYSIS

Water Users (2009 - 2010)

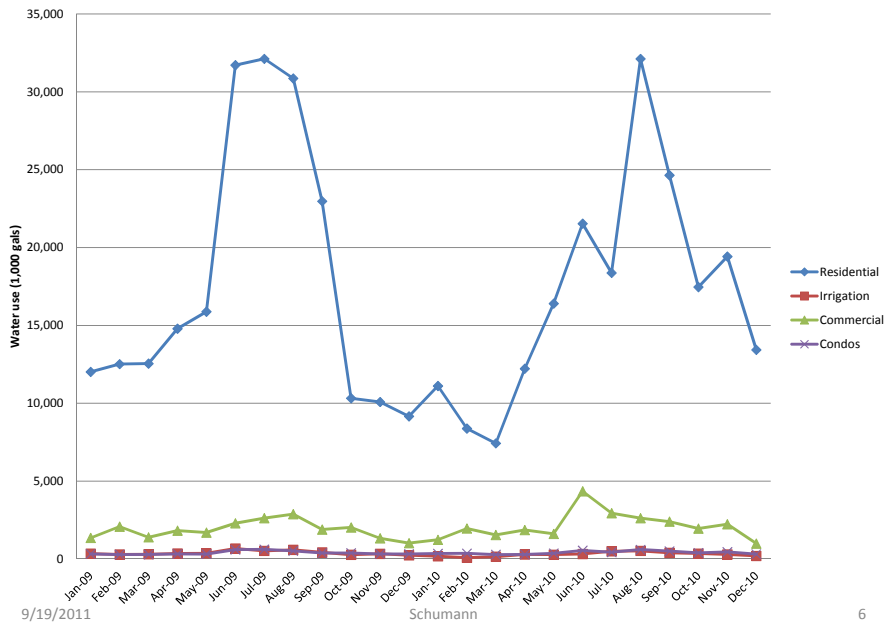


9/19/2011

Schumann

5

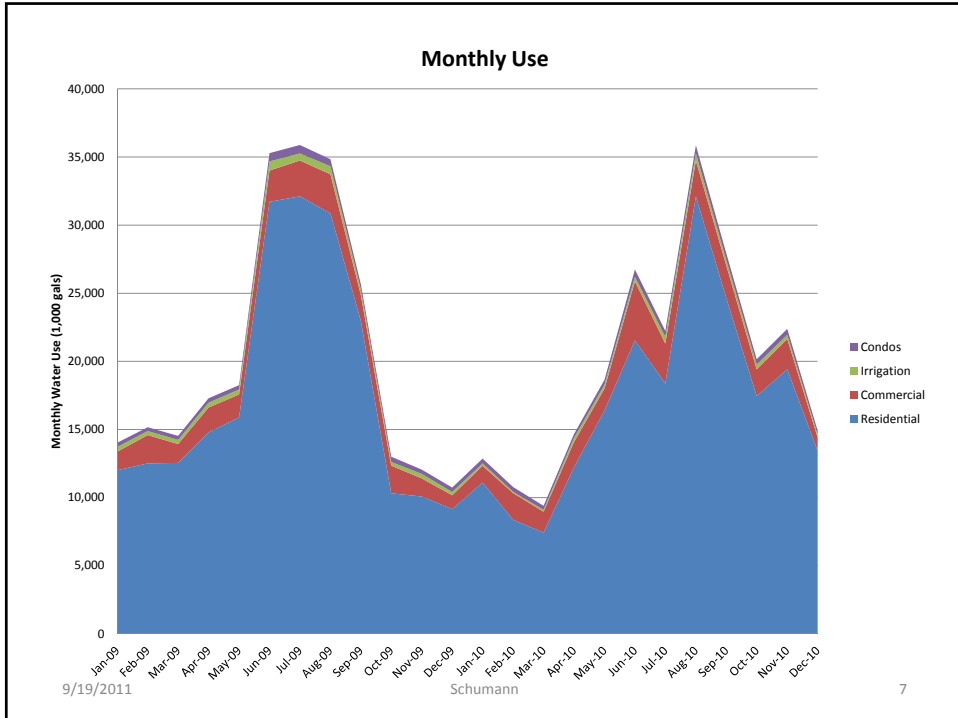
Monthly Water Use by Type



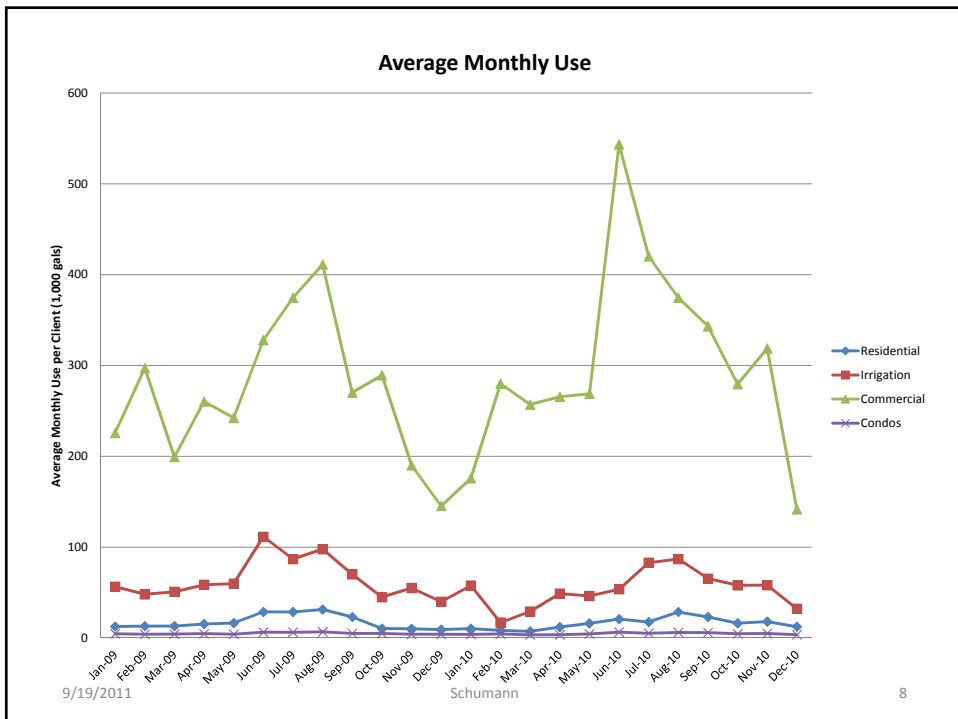
9/19/2011

Schumann

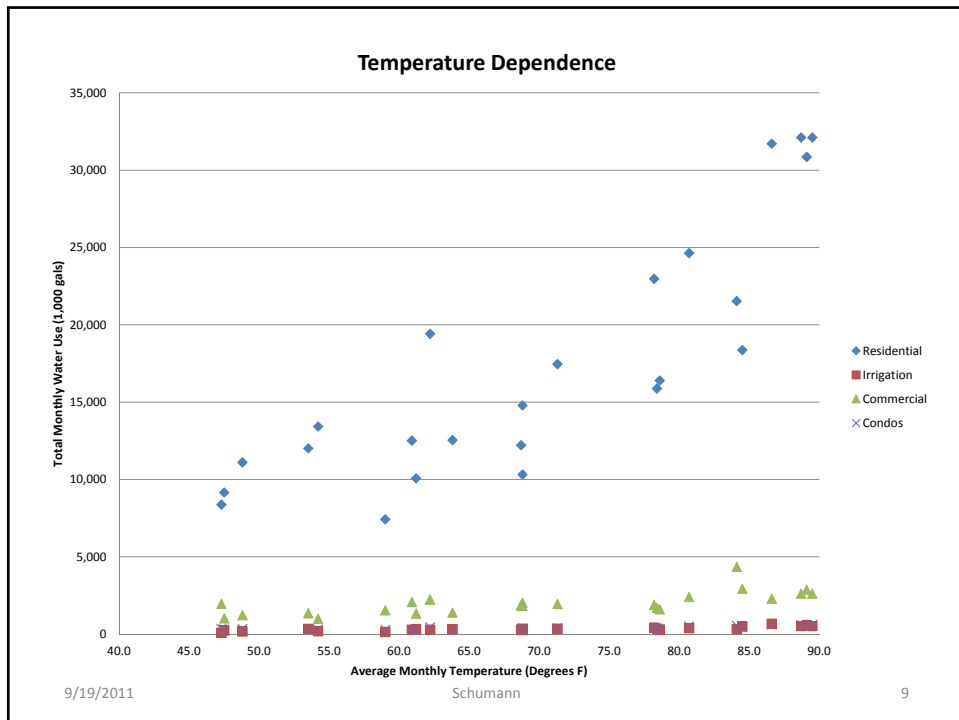
6



7



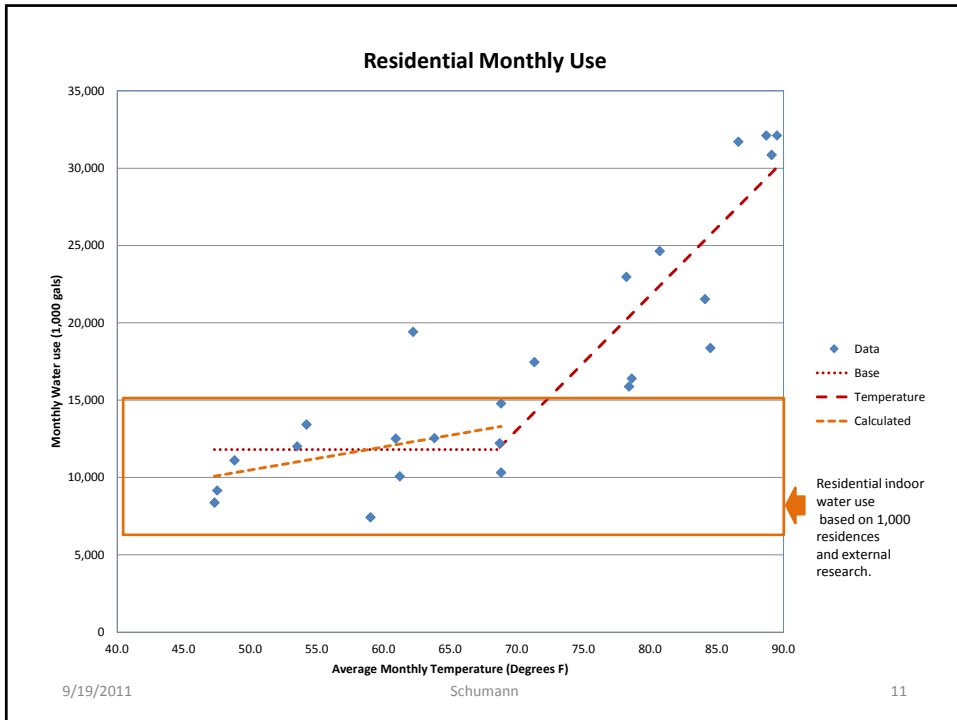
8



Water Use Correlation with Temperature

Type	Correlation
Residential	0.85
Irrigation	0.83
Commercial	0.71
Condos	0.74

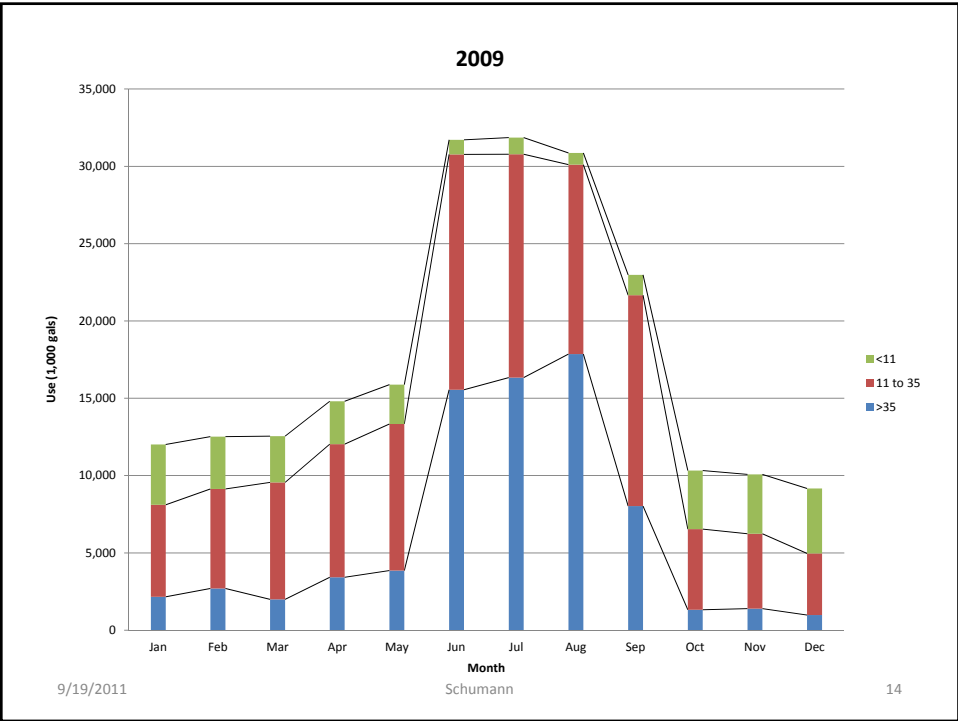
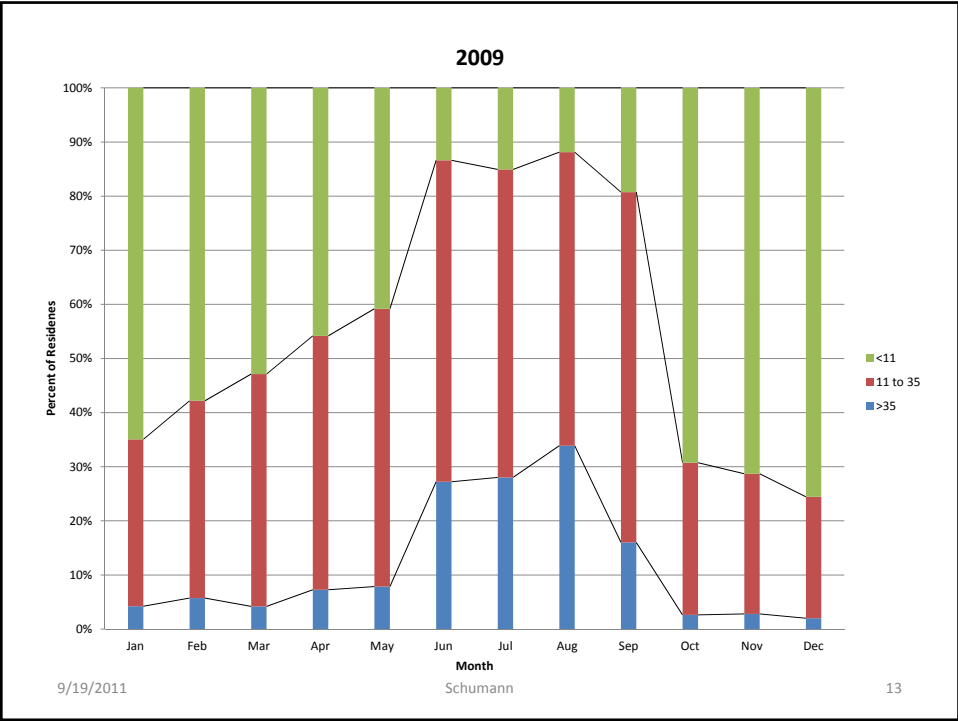
Correlation coefficient is a statistical measure of the linear relationship between two variables. It ranges between -1 and $+1$. The residential water use with rain was -0.09 .



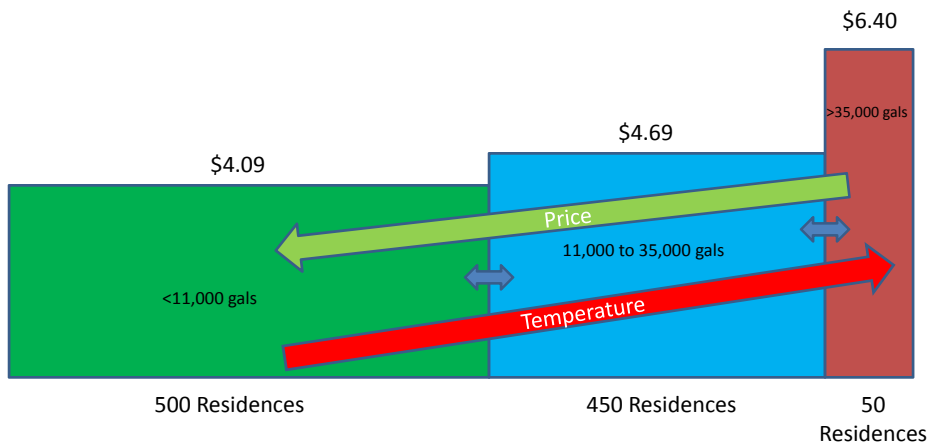
Tiered Rate (Increasing Block) Structure

Residential (1,000 gals per month)	Rate (per 1,000 gals)
Up to 10	\$4.09
11 to 35	\$4.69
Over 35	\$6.40

Adopted by the LCMUD Board at the last meeting.
 Reported as equivalent of a \$4.49 flat rate. The flat rate is based on Austin's Wholesale flat rate of \$4.01. This base rate from Austin is 18.6% higher than the current rate of \$3.38 per thousand gallons.



Tiered Pricing Structure (Increasing Block)



9/19/2011

Schumann

15

Impact of Tiered Pricing (increasing Block) on Residential Average Price

Year	2009	2010
Effective Average Price*	\$4.61	\$4.54
Target Average Price	\$4.49	\$4.49
Difference	\$0.12	\$0.05
Percent Difference	3%**	1%**

* Price per 1,000 gals

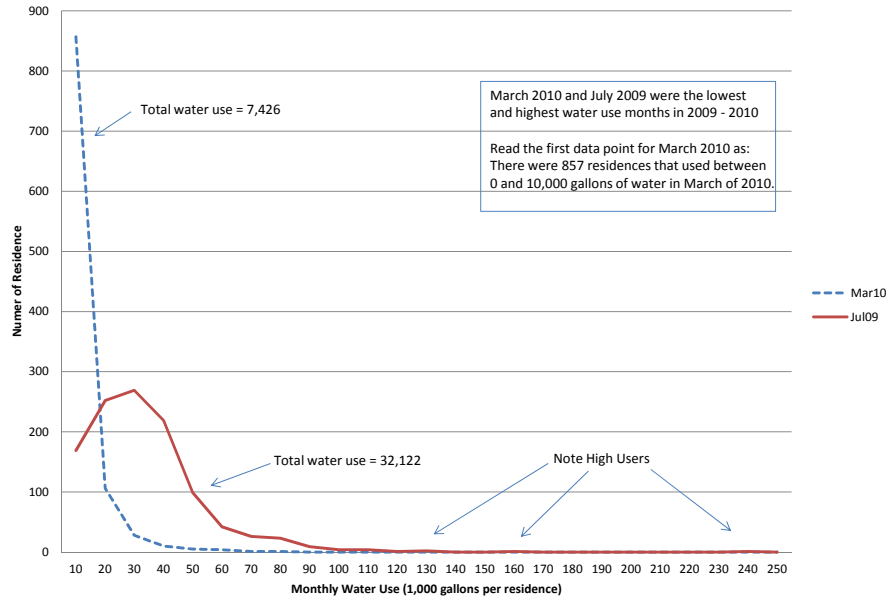
** Difference probably due to inclusion/exclusion of condos

9/19/2011

Schumann

16

Comparison of Frequency Distributions

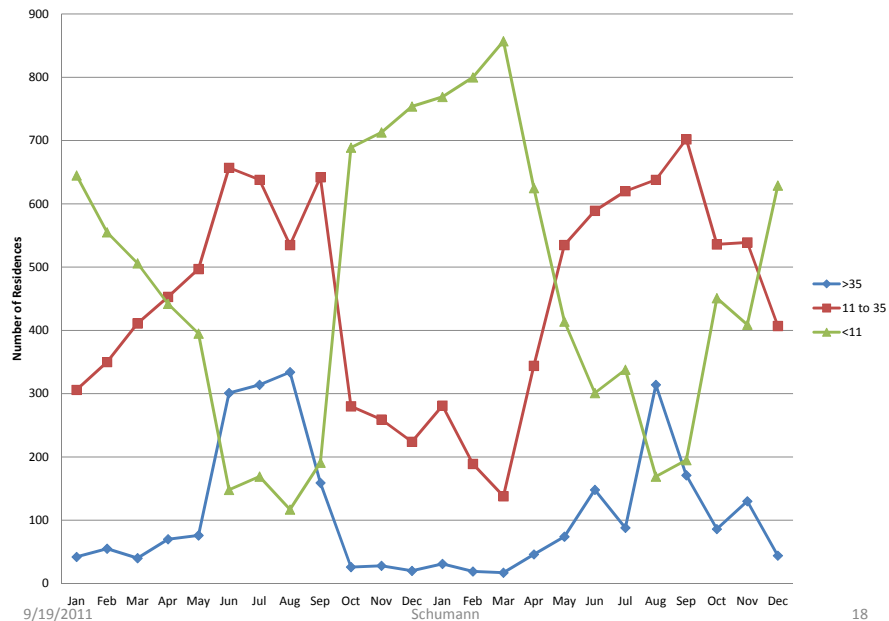


9/19/2011

Schumann

17

Number of Residences in Tiers (2009 - 2010)



9/19/2011

Schumann

18

Tier Pricing (Increasing Block) Difficulties

- 12 equations (monthly)
- 6 unknowns
- Distribution changes month to month
- Pricing and conservation programs affect distribution
- Distribution changes year to year

$$PW = \frac{\{(P1 \times V1) + (P2 \times V2) + (P3 \times V3)\}}{(V1 + V2 + V3)} + CO$$

PW – wholesale price
 P1 – first block price
 P2 – second block price
 P3 – third block price
 V1 – first block volume
 V2 – second block volume
 V3 – third block volume
 CO – overhead cost

WATER PRICING RESEARCH

US Residential Price Structures

Price Structure*	1996	1998	2000	2002
Decreasing Block	36%	35%	35%	30%
Uniform Price	32%	34%	36%	36%
Increasing Block	32%	31%	29%	30%

* Block – prices are tiered (flat over regions), decreasing – price goes down as volume increases, increasing – prices go up as volume increases

Source: Reference 6

Price Elasticity for Residential Water

Source	Price Elasticity
Nataraj (1995), Reference 5	-0.15 to -0.25*
Olmstead (2007), Reference 6	-0.3 to -0.4
Stevens (1992), Reference 6	-0.10 to -0.69
Stevens & Kesisoglou (1984), Reference 6	-0.10** to -0.38
Males (1979), Reference 6	-0.32
Turnovsky (1962), Reference 6	-0.05 to -0.40
Turnovsky (1965), Reference 6	-0.29 to -0.41
Espey (1997), Reference 6	-0.51****, -0/38**, -0.64***
Dalhuisen (2003), Reference 6	-0.41****
Olmstead (2006), Reference 6 & 7	-0.33

* High use consumers. Higher if near lower boundary of block pricing

** short run

*** long run

**** median

Price elasticity – ratio of % change in demand for a 1% change in price

(http://en.wikipedia.org/wiki/Price_elasticity_of_demand)

Estimated Residential Water Use Savings

- 2009
 - -11,213,000 gallons
 - - 5.2%
- 2010
 - -9,419,000 gallons
 - - 4.7%

* Based on median best estimate of price elasticity of -0.35, Reference 6

** Based on equivalent weighted average tier (increasing block) prices

*** If pricing structure was in place for one of those years

**** Flat rates produce the same savings

WATER CONSERVATION RESEARCH

Summary of Conservation Methods

Type	Average	Low	High
Price*	35%	5%	69%
Conservation	26%	13%	37%
Both**	18%	6%	37%

Reduction in water used based on method.

*Based on 100% increase in price

** Unknown price increase

Estimates of the Base (Indoor Use) of Residential Water Use

Method	Indoor Use (1,000 gallons/month/residence)
Average of Non Watering Months	11.8
Trend Line Non Watering Months	10
Lowest Month	7.4
Based on Research*	7.3
Based on Calculation from Research**	6.2
Based on Calculation from Research**	8.3
Based on Research****	4.5 - 5.3

Reference 1

*41.9% average indoor use

** 69.3 gallons per capita per day, 3 persons per residence

*** 69.3 gallons per capita per day, 4 persons per residence

****Reference 2

Average Water Use

Category	Water Use (gallons per capita per day)	Percent of Indoor Water Use	Standard Water Use (gallons per capita per day)	Conservation Water Use (gallons per capita per day)
Baths	1.2	1.7%		1.2
Clothes Washers	15.0	21.6%		10.0
Dish Washers	1.0	1.4%		0.7
Faucets	10.9	15.7%		10.8
Leaks	9.5	13.7%		4.0
Showers	11.6	16.7%	13.4	8.8 - 11.3
Toilets	18.5	26.7%	19.5	8.2 - 9.5
Other	1.6	2.3%		1.6
Total	69.3		72.1	45.2 - 60.0

9/19/2011

References 1 and 3

27

Examples of Water Conservation Programs (Reference 4)

City	Program	Results
Albuquerque, NM	Water rates, public education program, high efficiency plumbing program, landscaping program, large use program	Peak demand in 2002 down 14% from 1990
Ashland, OR	System leak detection & repair, water rates, showerhead replacement program, toilet retrofits & replacement	Water savings of 395,000 gallons per day (16% of winter usage) and reduction in wastewater volume
Cary, NC	Public education, landscape and irrigation codes, toilet flapper rebates, residential audits, conservation rate structure, new homes points program, landscape water budget, water reclamation facility	Estimated 16% by 2028 (4.6 mgpd)
Gallitzin, PA	Accurate meter reading and system map, leak detection and repair program	87% drop in unaccounted for water, 59% drop in production
Gilbert, AZ	Building code requirements, increasing block water rate structure, metering program, public education, low water use landscaping program	Successful in reusing reclaimed water
Goleta, CA	Plumbing retrofits, high efficiency toilets, high efficiency shower heads, increased rates	30% drop in water use

9/19/2011

Schumann

28

Examples (cont.)

City	Program	Results
Houston, TX	Education program, plumbing retrofits, audits, leak detection and repair, increasing block rate schedule, conservation planning	Reduction in water demand of 7.3%, savings of \$260 million
Irvine Ranch Water District, CA	Five tiered rate structure	19% decline in water use
Massachusetts Water Resources Authority	Leak detection and repair, plumbing retrofits, water management programs, education program, meter improvements	24% drop in water use over ten years
Metropolitan Water District of Southern California	Plumbing fixture replacement, water efficiency surveys, irrigation improvements, training programs, conservation related research projects	Savings of 59 mgd
New York, NY	Education, metering, leak detections, water use regulation, comprehensive toilet replacement program	Reduced per capita water use from 195 gpd (1991) to 167 gpd (1998), 14%. Reduced water/waste water bills by 20% to 40%
Phoenix, AZ	Pricing reform, residential and industrial/commercial conservation, landscaping, education, technical assistance, regulations, planning and research, interagency coordination	Saved 40mgd. Conservation rate structure saved 9 mgd.

9/19/2011

umann

29

Examples (cont.)

City	Program	Results
Santa Monica, CA	Water use surveys, education, landscaping, toilet retrofits, load program	Reduced water use by 14% and waste water flow by 21%
Seattle, WA	Seasonal rate structure, plumbing fixture codes, leak reduction, incentives for water saving products, public education	Water consumption dropped by 20%
Tampa, FL	High efficiency plumbing retrofits, increasing block rate structure, irrigation restrictions, landscaping measures, public education	25% drop in water use from landscaping program, 15% reduction from retrofit program
Wichita, KS	Integrative resource planning	27 conventional and nonconventional resource options
Barrie, ON	Replacing inefficient showerheads and toilets	Reduced water flow by 14.5 gpd

9/19/2011

Schumann

30

References

1. Nature of Residential Water Use and Effectiveness of Conservation Programs, James Heaney, William DeOreo, Peter Mayer, Paul Lander, Jeff Harpring, Laurel Stadjuhar, Beorn Courtney and Lynn Buhlig, <http://bcn/boulder.co.us/basin/local/heaney.html>
2. Residential Water use Trends in North America, Thomas Rockaway, Paul Coomes, Joshua Rivard and Barry Kornstein, Journal of the AWWA, February 2011, <http://www.awwa.org/files/Resources/Waterwiser/JAW0211rockaway.pdf>
3. Water Use Statistics, American Water Works Association, Drinktap.org, <http://www.drinktap.org/consumerdnn/Home/WaterInformation/Conservation/WaterUseStatistics/tabid/85/Default.aspx>
4. Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs, EPA, 2002, http://www.epa.gov/WaterSense/docs/utilityconservation_508.pdf
5. Do Residential Water Consumers React to Price Increases?: Evidence from a Natural Experiment in Santa Cruz, Shanthi Nataraj, Giannini Foundation of Agricultural Economics, University of California, http://giannini.ucop.edu/media/are-update/files/articles/v10n3_3.pdf
6. Managing Water Demand: Price vs. Non-Price Programs, Sheila Olmstead & Robert Stavins, A Pioneer Institute White Paper #39, Pioneer Institute, July 2007, http://www.hks.harvard.edu/fs/rstavins/Monographs_&_Reports/Pioneer_Olmstead_Stavins_Water.pdf
7. Does Price Structure Matter?: Household Water Demand Under Increasing-Block and Uniform Prices, Sheila Olmstead, W. Hanemann & Robert Stavins, School of Forestry and Environmental Studies, Yale University, 10/30/03, http://www.esm.ucsb.edu/academics/courses/595EE/Readings/olmstead_hanemann_stavins.pdf

APPENDIX

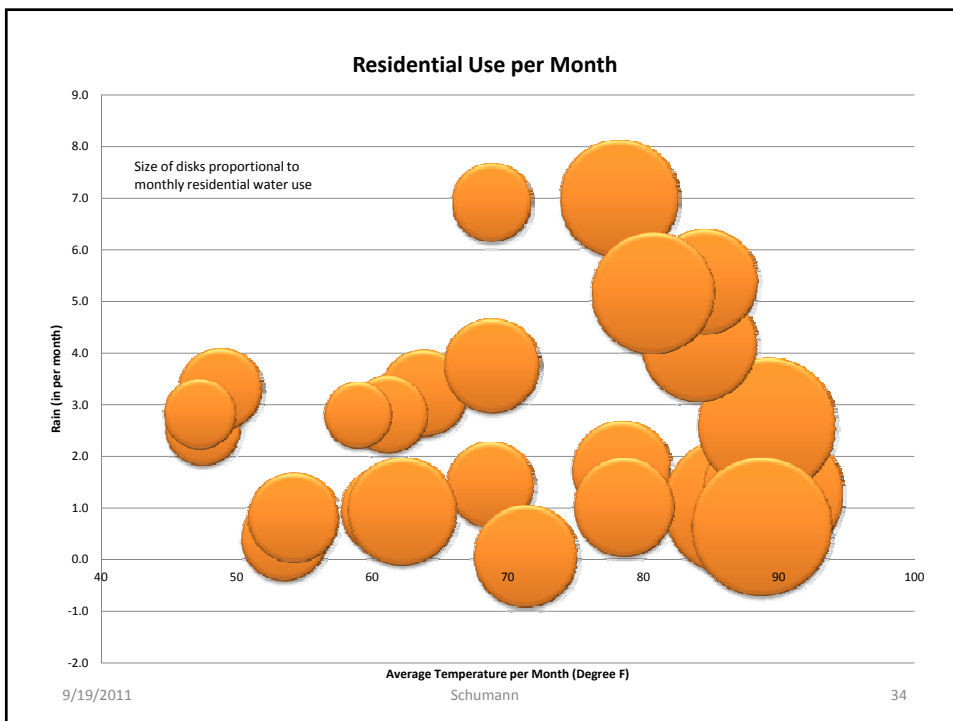
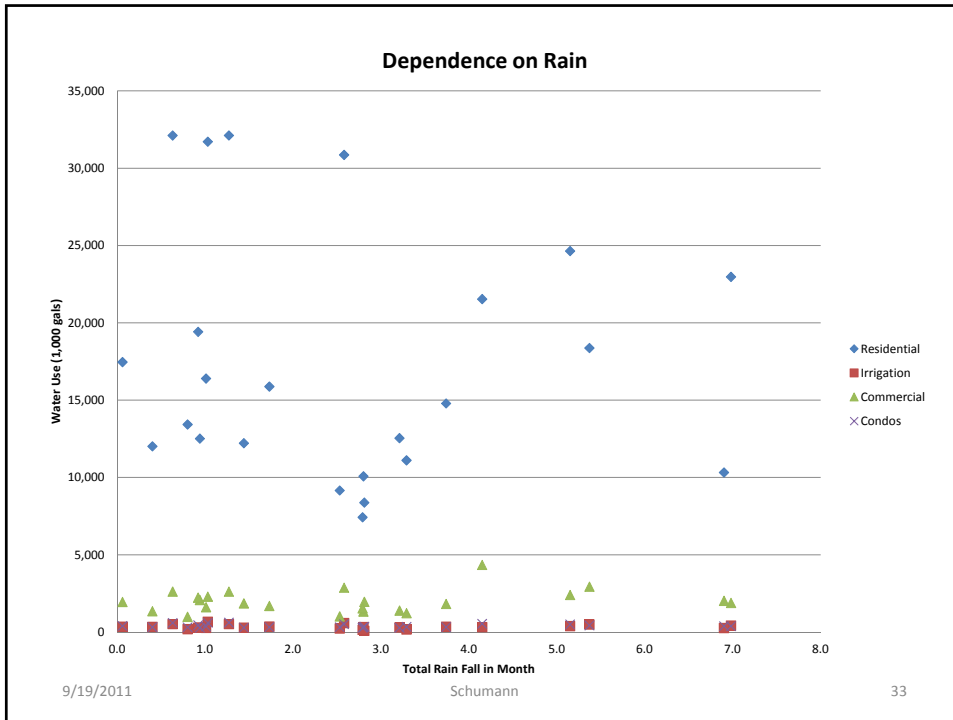
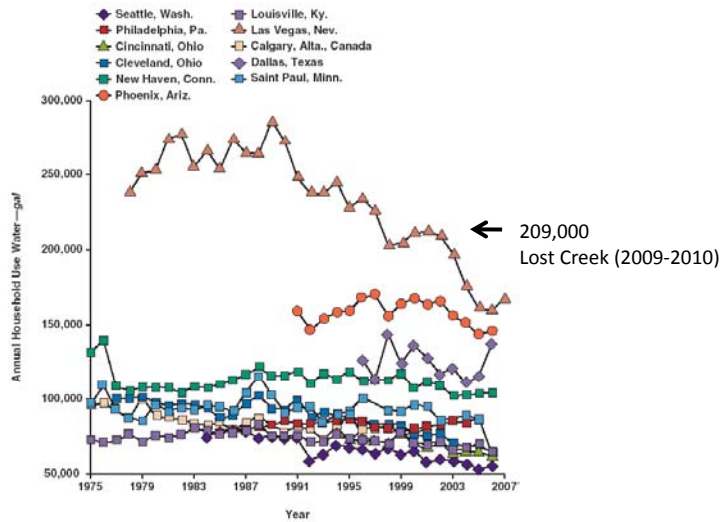


FIGURE 1 Overview of 11 regional partner utilities' water use



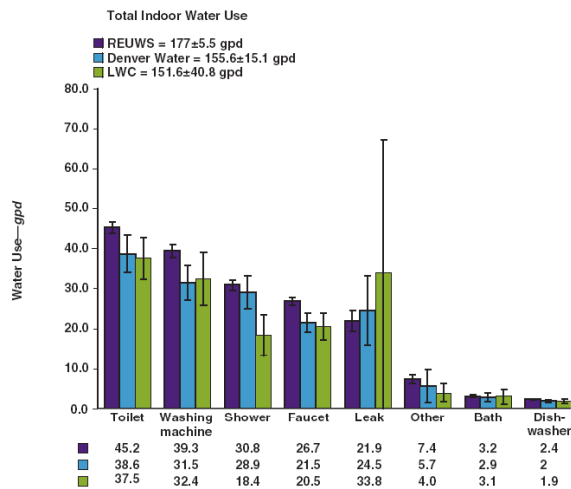
Source: Coomes, P., T. Rockaway, J. Rivard, and B. Kornstein. North American Water Usage Trends Since 1992. ©2010 Water Research Foundation. Reprinted with permission.

9/19/2011

Schumann

35

FIGURE 5 Comparison of average daily household indoor water use



Source: Coomes, P., T. Rockaway, J. Rivard, and B. Kornstein. North American Water Usage Trends Since 1992. ©2010 Water Research Foundation. Reprinted with permission.

LWC—Louisville (Ky.) Water Company, REUWS—Residential End Use Water Study

Data compiled from LWC (2007), Denver Water (2006), and Mayer et al (1999).

9/19/2011

Schumann

36

Residential Indoor/Outdoor Water Use

City	Total (1,000 gals/year)	Indoor (%)	Outdoor (%)
Boulder, CO	134.1	42.8%	57.2%
Denver, CO	159.9	40.3%	59.7%
Eugene, OR	107.9	59.2%	40.8%
Las Vigenes, CA	301.1	23.8%	76.2%
Lompoc, CA	103	61.1%	38.9%
Phoenix, AZ	172.4	41.3%	58.7%
San Diego, CA	150.1	37.2%	62.8%
Scottsdale/Tempe, AZ	184.9	33.5%	66.5%
Seattle, WA	80.1	61.8%	38.2%
Tampa, FL	98.9	54.5%	45.5%
Walnut, CA	208.8	36.1%	63.9%
Waterloo, ON	69.9	77.7%	22.3%
Average	147.6	41.9%	58.1%
Lost Creek	208.7	42.5%	57.5%

9/19/2011

Reference 1

37

Residential Indoor Water Use (gallons per day per residence)

Study	REUWS	Denver Water	LWC
Toilet	45.2	38.6	37.5
Washing Machine	39.3	31.5	32.4
Shower	30.8	28.9	18.4
Faucet	26.7	21.5	20.5
Leak	21.9	24.5	33.8
Other	7.4	5.7	4.0
Bath	3.2	2.9	3.1
Dishwasher	2.4	2.0	1.9
Total	176.9	155.6	151.6

Reference 2

9/19/2011

Schumann

38

Author

- Paul Schumann
- 512.632.6586 (cell)
- 512.327.5449
- paschumann2009@gmail.com